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## Letters to the Editor

**Assessment of cardiac dysfunction by dissipative energy loss derived from vector flow mapping****Keywords:**

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In a recent article published in the journal, Hayashi et al. [1] established the reference value of dissipative energy loss (EL) within left ventricle (LV) in healthy children aged 1–15 years and illustrated the clinical application of EL calculation in a child with aortic coarctation, who had abnormally elevated diastolic EL. According to their hypothesis, diastolic EL would be useful in assessing patients with LV diastolic dysfunction and preserved LV systolic function, while they postulated that in patients with impaired LV systolic function, both the systolic and diastolic EL would decrease in accordance with the decrease in the total fluid energy of blood flow. We fundamentally appreciate their work in EL calculation, but we have concerns related to the impact of cardiac dysfunction on the dissipative EL.

First, the above speculation that EL would decrease concomitantly with LV systolic dysfunction is inappropriate. EL is calculated from the square of the difference of adjacent velocity vectors [1,2]. Abnormal turbulent flow caused by valvular stenosis or regurgitation will disturb the velocity vector distribution and result in increased EL. In congestive heart failure due to valvular disease, although cardiac output is decreased, intraventricular inefficient turbulent flow could still generate an elevated EL. Stugaard et al. [2] demonstrated obviously increased LV EL in an aortic regurgitation patient with preserved ejection fraction, and EL could be a novel index to grade the severity of aortic regurgitation. Further research is needed to investigate the intraventricular EL change in valvular disease complicated by cardiac decompensation.

Besides, the clinical implication of systolic EL should not be overlooked while more attention has been paid to the diastolic EL. Although the amount of systolic EL is smaller compared to the diastolic EL and appears insignificant in the evaluation of intraventricular blood flow efficiency [1,3], in diseased ventricles that are exhausted to maintain normal ejection fraction, the assessment of systolic efficiency might provide us with more clues about cardiac compensation and remodeling. Studies using tissue Doppler imaging and strain imaging have demonstrated impaired systolic function in heart failure patients with preserved LV ejection fraction [4,5], as there is tight coupling between cardiac relaxation and contraction, the tracking of systolic EL and diastolic EL along the full cardiac cycle could promote the understanding of the link between intermittent cardiac phases.

In conclusion, it has been recognized that cardiac dysfunction is a heterogeneous syndrome and new echocardiographic parameters could help in defining subphenotypes in this population. Dissipative EL derived from vector flow mapping could serve as a quantitative parameter to evaluate the efficiency of intraventricular blood flow and delineate cardiac dysfunction in terms of fluid dynamics.

**References**

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We appreciate the insightful comments by Zhong et al. on our original article [1]. The points discussed in the letter are of great significance for understanding the clinical implication of intraventricular dissipative energy loss (EL) within the left ventricle (LV).